

Sediment Removal Techniques for Reservoir Sustainability

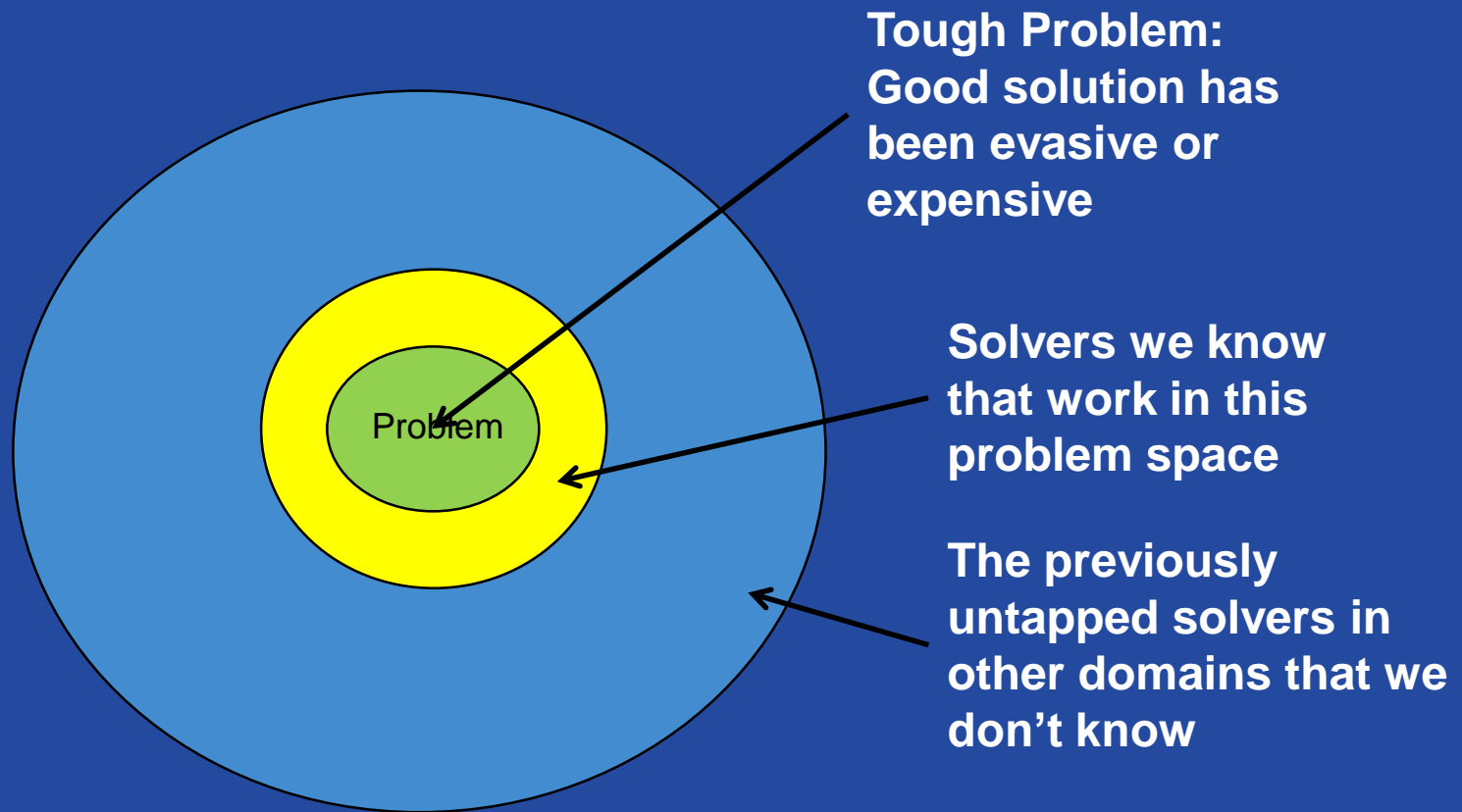
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Prize Competitions address tough problems, where solutions have been evasive or expensive, by opening up the problem area to previously untapped domains



Prize Competition = Online “Crowd Sourcing” for Solutions

Crowdsourcing: The practice of obtaining needed services, ideas, or content by soliciting contributions from a large group of people and especially from the online community rather than from traditional employees or suppliers

- Merriam Webster Dictionary



Prize Authorities

- **The Strategy for American Innovation, announced by the White House in September 2009, urged agencies to increase their ability to promote innovation with tools such as prizes and challenges**
- **Fed agencies authorized to use appropriated dollars for prize competitions under the America COMPETES Act of 2010 (15 USC 3719)**
- **In 2010, OMB “Guidance on the Use of Challenges and Prizes to Promote Open Government**
- **Reauthorized under 15 U.S.C. 3719 - PRIZE COMPETITIONS**

Prize Competitions Supported by the White House

“Throughout history, competition has brought out the best in Americans and driven them to break through barriers, opening the door to stunning achievements....In this country competitive spirit has unleashed incredible innovation and turned fiction into reality.”

*Rick Perry
Roundtable on Federal Prize
Competitions
March 13, 2018*



RECLAMATION

Managing Water in the West



U.S. Department of the Interior
Bureau of Reclamation

WATER

PRIZE COMPETITION CENTER

<https://www.usbr.gov/research/challenges>

Water Availability



Environmental Compliance



Infrastructure Sustainability



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Bureau of Reclamation

WATER

PRIZE COMPETITION CENTER

Sumner Dam, NM

1937



RECLAMATION
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**Can you help us
remove sediment
from reservoirs?**

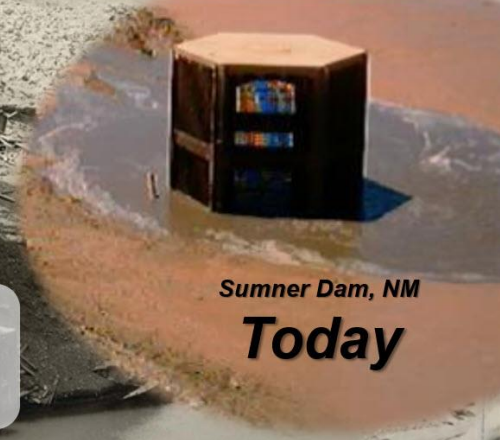
\$75,000 in prize \$\$\$

www.usbr.gov/research/challenges/sediment-removal.html

Launch Fall 2018

Sumner Dam, NM

Today



<https://www.usbr.gov/research/challenges/sediment-removal.html>

Collaboration is vital.....

- Working with others passionate about solving water problems leverages capabilities, creates broader impact, and catalyzes success.
- To date, we have fostered collaboration with other Federal agencies, state and local governments and the private sector

RECLAMATION Our Federal Collaborators: *Managing Water in the West*



Other Collaborators:



Reservoir Sediment Prize Competition Collaborators



**Federal Energy
Regulatory
Commission**



**Natural Resource
Conservation Service**



All Rivers Naturally Transport Sediment

Sediment Sizes:

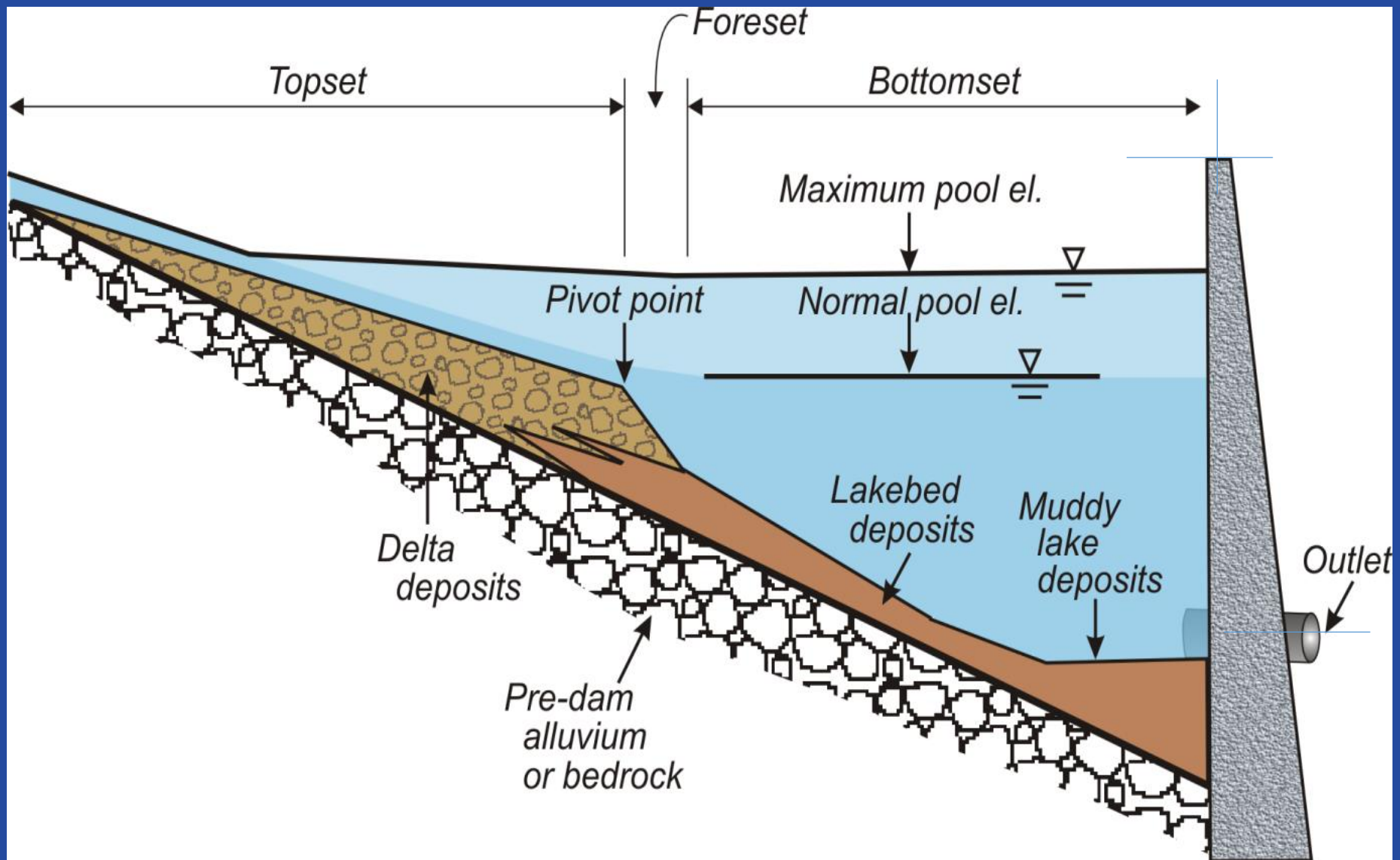
- Clay
- Silt
- Sand
- Gravel
- Cobble
- Boulder



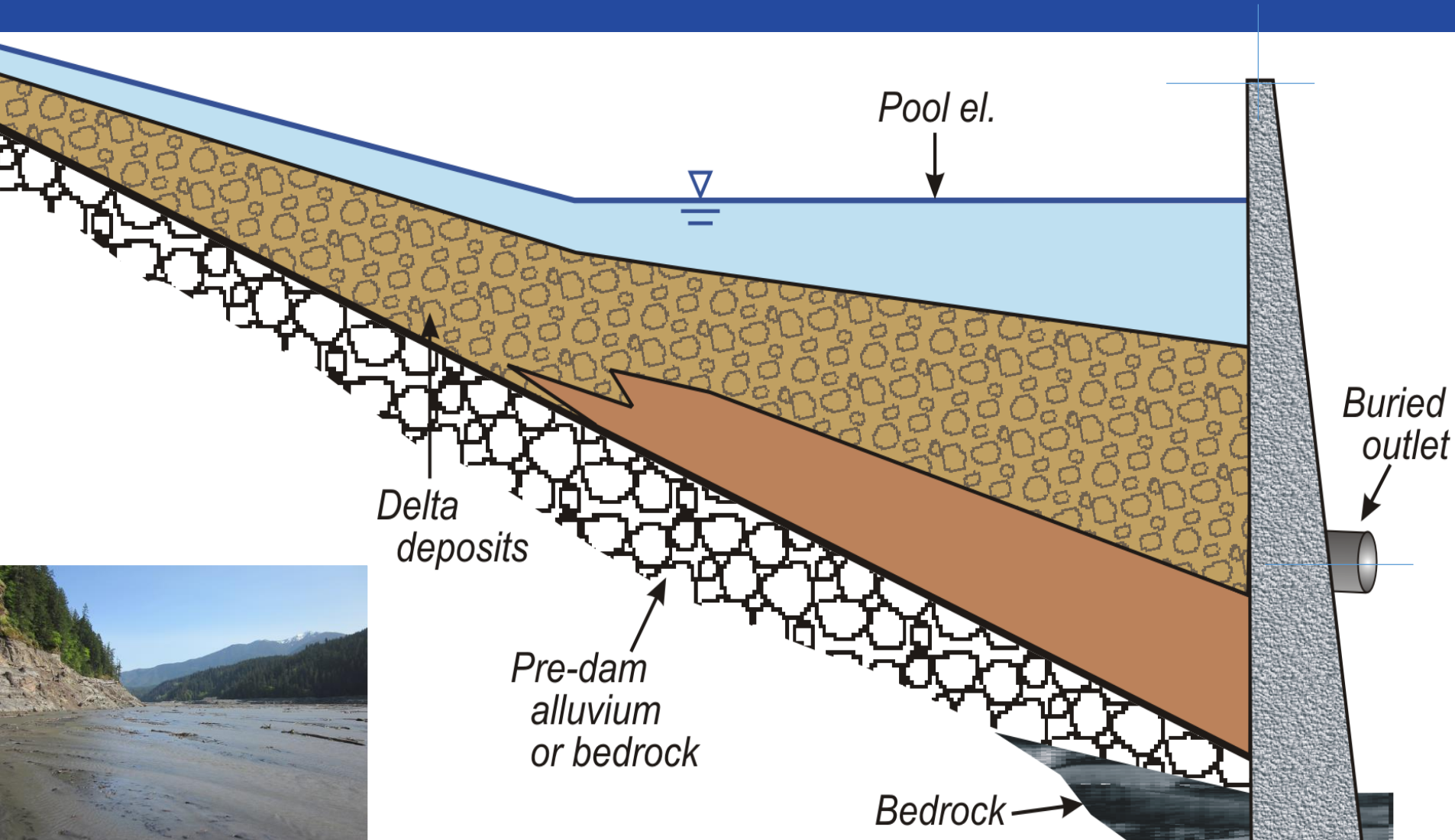
Reservoirs tend to trap this sediment



Reservoir Sedimentation



Reservoir Sedimentation

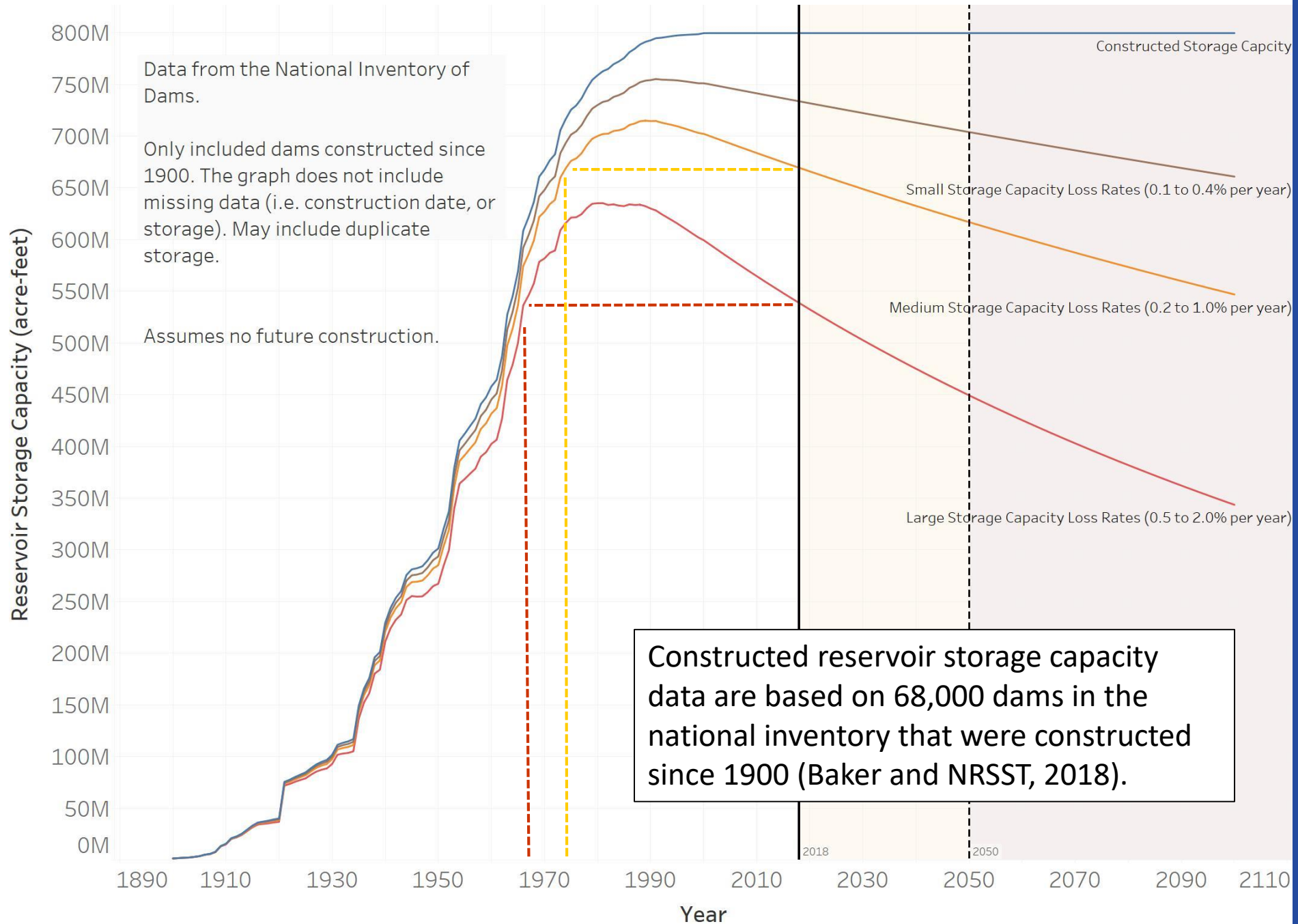


Existing Reservoir Practice

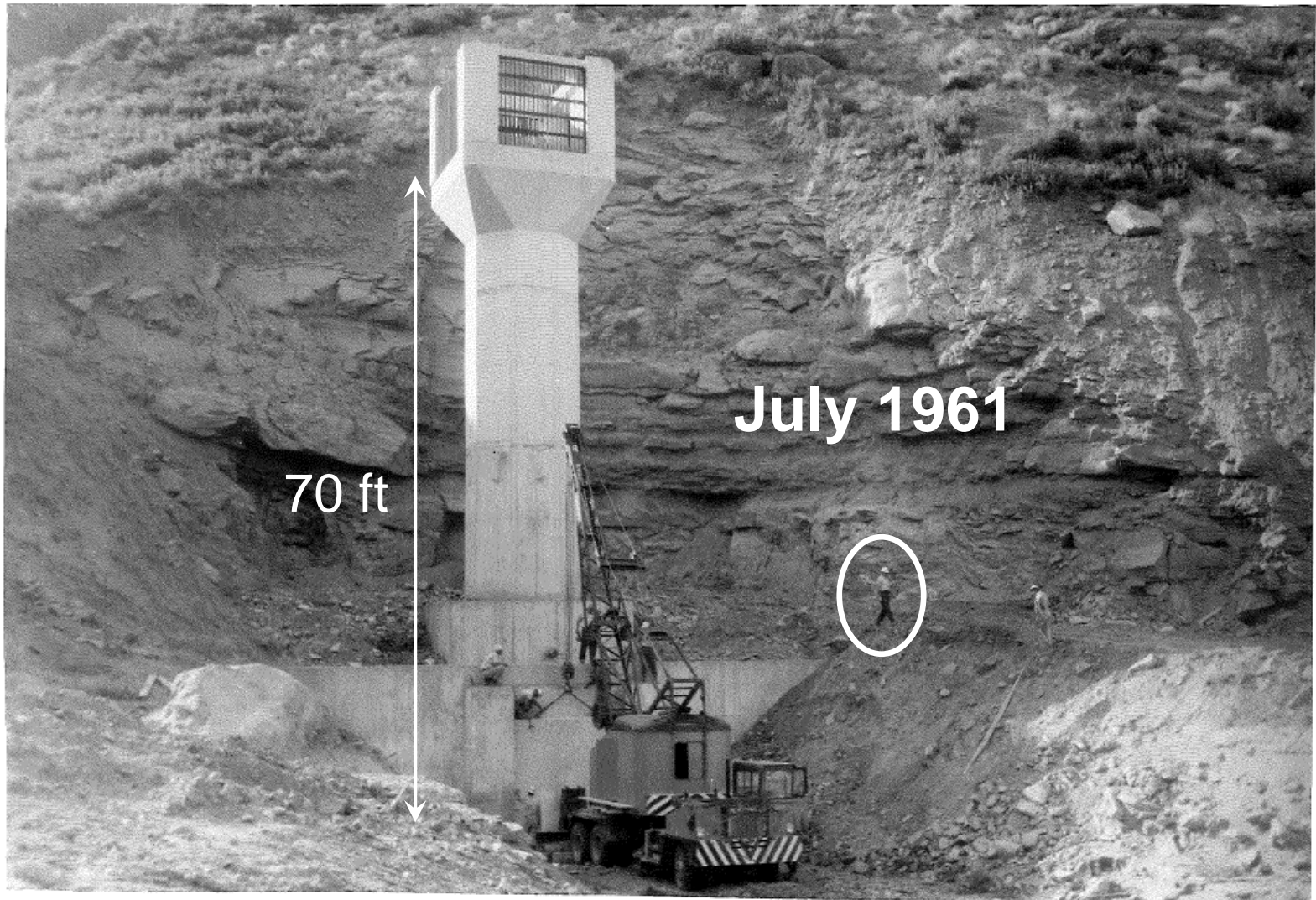
- In the United States, reservoirs are functioning as originally planned, which also means they trap sediment.
- People may not be aware that the numerous benefits provided by the nation's reservoirs are not sustainable over the long term without sediment management.



Changes to U.S. Reservoir storage capacity due to dam construction and sedimentation



Paonia Dam and Reservoir, CO



Without Reservoir Sediment Management

The eventual costs can be expensive:

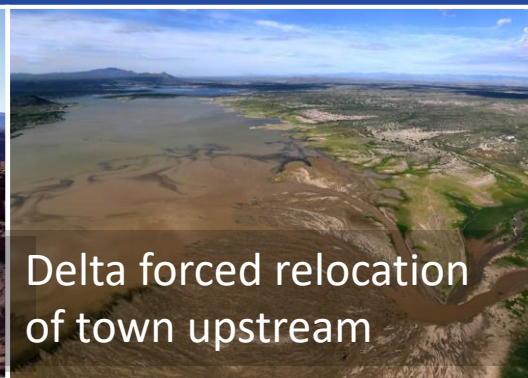
- Lost storage capacity over time (with increased water demands over time)
- Buried or impaired dam outlets, reservoir water intakes, boat ramps & marinas



Without Reservoir Sediment Management

The eventual costs can be expensive:

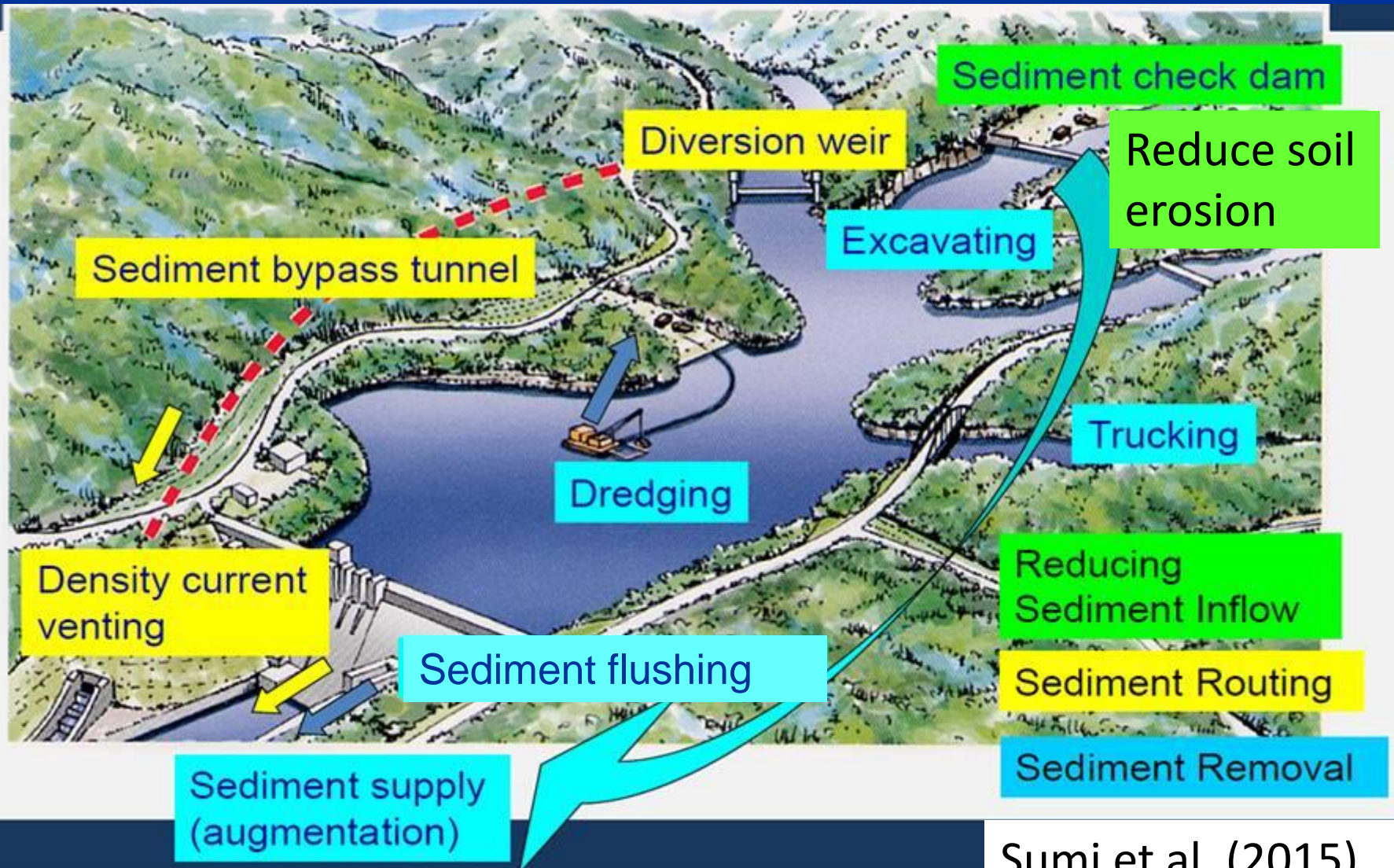
- Abraded turbines, outlets, or spillways
- Reduced surface area for lake recreation
- Upstream channel aggradation and increases in flood stage and groundwater
- Downstream channel and habitat degradation



Typical Federal Reservoir and Sediment Characteristics

- Length: 1 to 30 miles
- Annual sediment inflow: 10s to 100s acre-ft/yr
- Sediment submergence depths: 1 to 200 ft
- Sediment sizes: clay, silt, sand, and gravel
- Submerged wood: twigs to logs
- Seasonal pool fluctuations: 2 to 20 ft
- Annual pool fluctuations: 5 to 50 ft
- Height of dam above reservoir pool: 20 to 100 ft
- Height of dam above downstream river channel: 50 to 300 ft

Reservoir Sediment Management Solutions



Sumi et al. (2015)

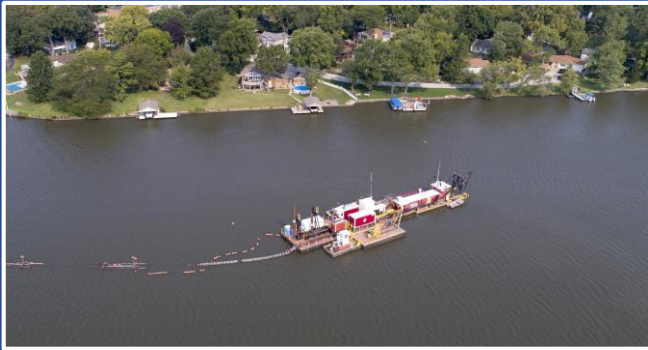
Possible Reservoir Sediment Management Strategy

- Focus on managing recent or future sedimentation rather than past sedimentation
- Manage sedimentation each year
- Over the long term, sediment will have to pass downstream and possibly supply other beneficial uses



Reservoir Sediment Removal is the Focus of this Prize Competition

- Existing Technologies:
 - Conventional dredging: hydraulic & mechanical



- Dry excavation



Reservoir Sediment Removal is the Focus of this Prize Competition

- Existing Technologies:
- ~~Hydraulic scour (pressure & empty flushing)~~



- Viable solutions at some reservoirs, but not part of this competition because it would use too much reservoir water at many locations

Conventional Dredging:

- Mechanical or hydraulic dredging or dry excavation
 - Transport by slurry pipeline, truck, or conveyor belt
 - Discharge to the downstream river channel, disposal site, or beneficial use



Dredging Costs

- Hydraulic dredging tends to be less expensive than mechanical excavation, but dredging costs can vary widely:
 - \$3/yd³ to \$60/yd³ or
 - \$5,000/acre-foot to \$100,000/acre-foot
- Dredging costs generally increase with
 - collection depth, transport distance, and transport elevation above pool
 - abrasive characteristics of sediment
 - level of contamination
 - delivery requirements



Prize Competition Areas

- **Propose a new method for sediment removal that minimizes the future loss of reservoir capacity due to sedimentation:**
 - **Sediment Collection**
 - **Sediment Transport**
 - **Sediment Delivery**

New Ideas are Needed

- **Reduce the cost of collecting and transporting sediment**
- **Efficiently collecting sediment from depths greater than 60 feet**
- **Deliver sediments to the downstream river channel in ways that reduce the environmental impact to aquatic resources and infrastructure**

Things to Avoid:

- **A review of existing technology**
- **Solutions that rely on**
 - **Sediment yield reduction**
 - **Reservoir sediment flushing or bypassing**
 - **Sediment delivery to confined disposal facilities**
- **Solutions that can only deliver sediment at a constant rate**
- **Solutions can only remove small volumes**
- **Solutions that block recreation access to large areas of the reservoir**

Competition Requirements

- **New and novel solution for either sediment**
 - collection from the reservoir,
 - transport from the reservoir past the dam, or
 - delivery to the downstream channel
- **Must meet General Solution Requirements and one of the Specific Solution Requirements**

General Solution Requirements

- **Potential to be less expensive than existing methods**
 - reducing labor costs
 - reducing power requirements
 - reducing required maintenance, breakdowns, or forced shut-downs
 - increasing removal capacity and efficiency
- **Capable of removing at least 50,000 yd³ of fine or coarse sediment per year**

General Solution Requirements (Continued)

- Utilize environmentally friendly methods that avoid or minimize impairment of reservoir water quality, noise pollution, or air pollution**
- Methods that avoid or minimize impacts to recreation access or use**

Sediment **Collection**

Requirements

- **Novel way to increase the efficiency that sediment can be collected from a reservoir or improvement upon conventional dredging**
- **Optional criteria:**
 - **Sediment collection from water depths between 60 to 100 ft**
 - **Ability to remove sediments with woody debris**

Sediment **Transport** Requirements

- Novel idea to transport sediment from the reservoir with seasonally fluctuating water levels (up to ± 25 ft per year) OR
- Improved efficiency when transporting sediment over distances of at least 2 miles
- Solution must be able to transport sediment at least 50 ft higher than the normal operating reservoir pool and 75 ft lower than the dam

Sediment **Delivery**

Requirements

- **Novel idea to deliver fine and coarse sediment to the downstream river channel**
- **Solution must have ability to control and vary the rates of sediment delivery as a function of downstream river flow rate and any seasonal requirements**

Project Deliverables (white paper)

- **Executive summary of proposed**
- **Identification specific solution topic
(collection, transport, or delivery)**
- **Detailed description of solution method**
- **New and innovative aspects of solution**
- **Rationale as to why solution will work**
- **Benefits of the solution**
- **References**

Use White Paper Template

Proposed Sediment Removal Techniques for Reservoir Sustainability

Solution Subtitle

Solvers must remain anonymous to the Judges

Executive Summary of Proposed Solution

Note to Solver: 800 words or less. This executive summary may be posted on Reclamation's webpage and used in other publications reporting the results of this Challenge.

Specific Solution Topic

Note to Solver: Identify one topic from the list below. Enter separate solutions for each topic, if more than one topic is addressed.

- *Sediment Collection*
- *Sediment Transport*
- *Sediment Delivery*

Technical Description of Method

Note to Solver: Include data, drawings, illustrations, photographs, specifications and any other material that supports the proposed solution.

Applicability of Solution to Federal Reservoirs

Note to Solver: Include narrative and summary table below.

Table 1. Summary Table of Solution Capabilities

General Capability	Value	Units
Capacity of proposed solution to collect, transport, or deliver sediment		yd ³ /year
Sediment size range proposed solution addresses		mm
<i>Note to Solver: Include rows from one of the solution topics below:</i>		
Sediment Collection		
Depth range at which sediment can be collected		feet
Sediment Collection		
Able to collect sediment with wood or debris		yes or no
Sediment Transport Efficiency		
Distance that solution would transport sediment		miles

Use White Paper Template

Strategy for Addressing Environmental Effects of Solution

Note to Solver: Describe what measures would be employed to avoid or reduce environmental impacts to reservoir water quality, fish, and wildlife.

Strategy for Addressing Effects of Solution on Lake Recreation

Note to Solver: Describe what measures would be employed to avoid or reduce impacts to lake recreation use.

New and Innovative Aspects of Solution

Note to Solver: Explain what aspects of the solution are new and have not been used before at federal reservoirs.

Rationale as to Why the Solution Will Work

Note to Solver: Explain the rationale or logic that makes the solution work.

Use White Paper Template

Benefits of the Solution

Cost

Note to Solver: Describe why the proposed solution has the potential to be less expensive than existing methods (e.g., hydraulic dredging). Use the list below, where applicable, as subheadings for this description.

- a. reducing the required labor*
- b. reducing the power requirements*
- c. reducing amount of maintenance, breakdowns or forced shut-downs*
- d. increasing removal capacity and efficiency*
- e. other*

Improved Efficiency

Note to Solver: Describe why the proposed solution may be more efficient than existing technologies (e.g., hydraulic dredging).

References

Note to Solver: Include any references that support the proposed solution.

Competition Judging

- Judging Panel of subject matter experts will evaluate the submissions and make a determination as to any possible winning solution(s)
- Qualifying solutions may win at least \$15,000
- Total prize purse is \$75,000

Questions?

